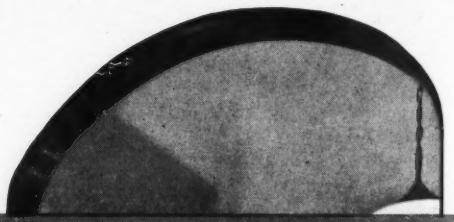
# The DENTAL DIGEST



DIAGNOSTIC AIDS

JULY, 1935
Vol. 41 — No. 7



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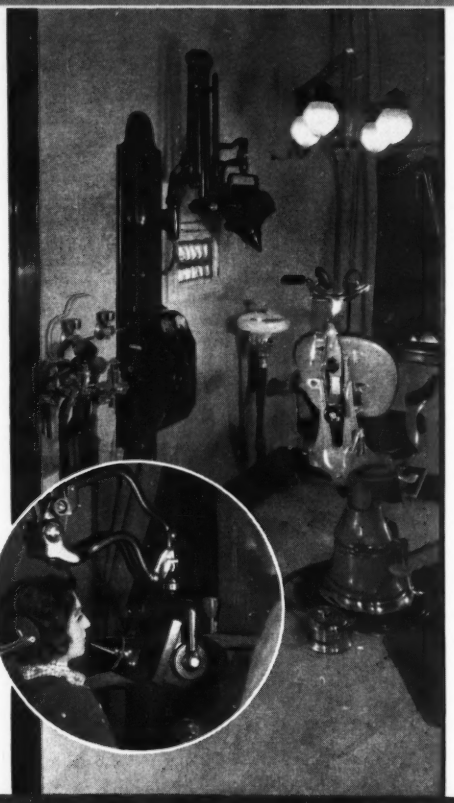

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# SPECIFIC TREATMENT OF PERIODONTAL DISEASE

P. H. BELDING, D.D.S., AND L. J. BELDING, M.D.
Waucoma, Iowa

AFTER years of empiricism the treatment of periodontal disease has been placed on an exact scientific basis and therapeutic procedures have been developed which permit its etiotropic cure. By the application of these procedures dentistry has been able to bring to a brilliant climax its conquest against periodontal disease.

The day of empiricism is past and the positive and specific cure of periodontal disease is an accepted and proved therapeutic fact. This revolutionary advance has been made possible by the demonstration that gingivitis, acute and chronic, pyorrhea, trench mouth, and Vincent's infection are merely different manifestations of the same disease and that all were specifically caused by the activity of the fusospirochetal complex and cured by spirocheticidal therapy.

The Chinese anticipated the fusospirochetal etiology of pyorrhea by using arsenic in its treatment—moreover, since the dawn of modern bacteriology, attention has repeatedly been called to the relationship of the oral spirochetes to gingival disease; but it was not until 1924 that the full significance of this relationship was understood. In that year Kritchevsky and Seguin,[1] working in the Pasteur Institute, demonstrated that there was no sound bacteriologic reason for refusing to accept the theory that pyorrhea and gingivitis were caused by the fusospirochetes and were in truth chronic manifestations of Vincent's infection, and that they should be classified as a form of spirochetosis and treated accordingly. Since then their observations have been substantiated by many workers throughout the world.

Recently David T. Smith[2] presented a comprehensive review of the literature and brought forth additional proof of the correctness of the original work of Kritchevsky and Seguin. This book is so outstanding, revolutionary, and scientifically exact that it cannot be too highly recommended to the dental profession to whom it is particularly addressed. Smith points out the unity of the types of spirochetosis; warns of the potential danger of gingival infection; describes the protean manifestations of this disease, and delineates measures of treatment. This book presents the greatest advances in dental bacteriology since the days of Miller, and should go a long way toward revolutionizing the present concept of gingival disease; promoting the acceptance of specific periodontal therapy, and convincing the skeptical of the fusospirochetal etiology of gingival disease.

[1]Kritchevsky, B. and Seguin, P.: The Pathogenesis and Treatment of Pyorrhea Alveolaris, D. Cosmos, 60:781, 1918. The Unity of Spirochetosis of the Mouth, D. Cosmos, 66:511, 1924.

[2]Smith, D. T.: Oral Spirochetes and Related Organisms in Fusospirochetal Disease, Baltimore, Williams and Wilkins, 1932.

## Predisposing Factors and Prevention

In an article of this nature, it is impossible to go into the intimate etiogenesis of pyorrhea, but in order to make therapeutic measures more understandable, it is necessary to present a few observations on the predisposing factors and the methods of physiologically preventing this disease. As in all bacterial infections, exposure, fatigue, malnutrition, or any factor that depresses resistance, either local or general, predisposes to this disease. Thus it is extremely important in the prevention of chronic destruction to maintain the normal gingival tonicity. It is inadvisable to delay treatment until subjective symptoms or gross evidences of the disease are present. Corrective measures should be instituted at the slightest evidence of gingival abnormality, for physiologic normalcy will always be the greatest defense mechanism against the ravages of gingivitis.

In the face of the ever-increasing incidence of chronic gingival infection, it is obvious why the general profession should at once adopt treatment measures compatible with the newer knowledge of the etiology of this disease.

A therapeutic rationale is therefore presented here which is based on the specific nature and unity of the gingivitides. We wish to point out that specific therapy is not a panacea but should be regarded rather as a keystone that completes the arch of periodontal therapy and places in the hands of the professions a weapon with which to rout an already disorganized foe. The success of this treatment depends on the restoration of physiologic normalcy; to that end standard practices of periodontia must be applied; the diet must be satisfactory; the general constitutional welfare promoted, and the cooperation of the patient secured if the ultimate prognosis is to be satisfactory.

In general dental spirochetosis can, for treatment purposes, be divided into two classes; the acute and chronic. In the majority of the cases, however, after the acute symptoms have subsided, it must be considered that a chronic infection still exists and must be treated accordingly.

## Medication

The following medications were standardized and used in the treatment of all cases, and are referred to in the article as prescription 1, 2, and 3: (1) a 12.5 per cent solution of bismuthous oxide, organically combined; (2) neoarsphenamine, 0.9 Gm.; glycerin, 40 cc.; solution of potassium arsenite (Fowler's solution), 60 cc.; (3) the bismuth ion incorporated in a dentifrice.

Prescription 1 is not commercially available and is released only for experimental purposes. The solution is that of a specific organic bismuth salt, the equivalent of 12.5 per cent of bismuthous oxide, in a semi-aqueous solvent which is slightly on the acid side, having a hydrogen ion concentration index of 6.25. To date we have not been able to produce a satisfactory preparation for a dentifrice containing the bismuth ion. We therefore prescribe a 10 per cent solution of prescription 1 or 2 and instruct the patient to soak the brush well in the solution before applying the tooth powder to the brush.

The object of specific therapy of the gingivitides is to secure the prompt and efficient destruction of the fusospirochetal complex by the topical application of the spirocheticidal drugs, mainly bismuth and arsenic preparations. Clinically this is accomplished in three ways: the professional application of concentrated reagents, the home use of a diluted mouthwash, and the addition of the bismuth ion to the dentifrice.

Prescriptions 1 and 2 are highly spirocheticidal medicaments and are

Fig. 1 A—Roentgenogram showing gingivitis without pocket formation and without bone destruction.

**TABLE 1—Periodontal Disease without Pocket Formation (Fig. 1,A).**

Figs. 2 through 9—Dotted line indicates position of the free margin of the gingivae.

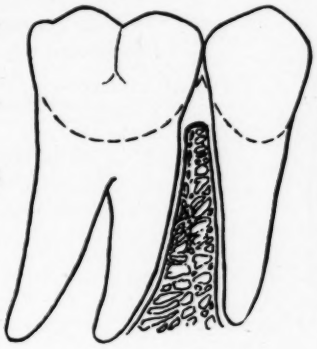
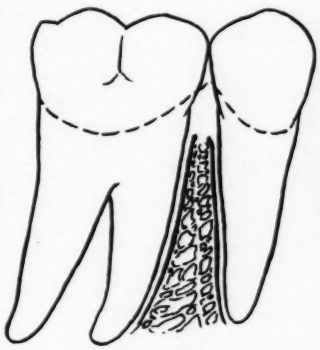
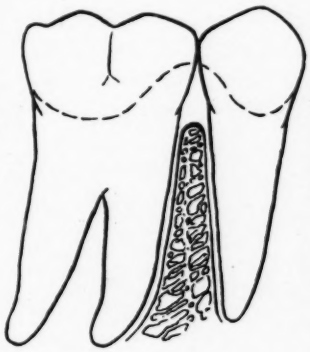
| Type | Pathologic Manifestations | Treatment |
|---|---|---|
| 1 | Inception of disease:<br>Slight gingival inflammation.<br>No destruction of coronal bone.<br>(Fig. 2.)<br>  | Elimination of predisposing causes (local and general).<br>Thorough prophylaxis.<br>Careful instruction of the patient in the mechanics of toothbrushing.<br>No medication is indicated. |
| 2 | Gingivae swollen, edematous.<br>May be slight hemorrhage on pressure.<br>Some interdental regions show definite destruction of coronal bone.<br>Periodontal membrane may be thickened.<br>Little or no calculus present.<br>(Fig. 3.)<br>  | Elimination of predisposing causes (local and general).<br>Diseased gingivae should be thoroughly medicated with either the bismuth or the arsenicals.<br>Thorough prophylaxis.<br>Home care same as in Type 1 but the dentrifice should contain a spirocheticide. |
| 3 | Hypertrophied gingivae.<br>Little or no calculus present.<br>Coronal bone may or may not be destroyed. (Fig. 4.)<br>  | Elimination of predisposing causes (local and general).<br>Specific therapy for one week.<br>Surgical removal of all hypertrophied tissue.<br>Thorough prophylaxis.<br>Specific home care (mouth wash) until gingivae heal sufficiently to tolerate brushing with a spirocheticidal dentifrice. |

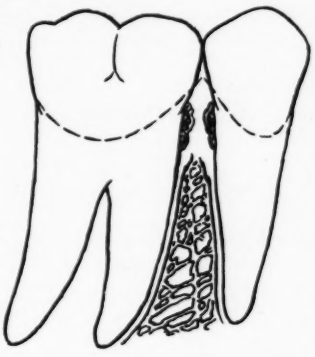
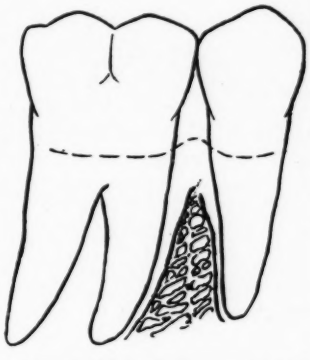
Fig. 1 B— Roentgenogram showing horizontal destruction.

**TABLE 2—Pocket Formation with Horizontal Destruction (Fig. 1,B).**

| Type | Pathologic Manifestations | Treatment |
|---|---|---|
| 1 | The appearance of the gingivae is not constant.<br>Mucoid exudate present.<br>Roentgenograms give a constant picture of the destruction of the coronal bone.<br>Calculus present. (Fig. 5.) | Elimination of predisposing causes (local and general).<br>Thorough prophylaxis.<br>Subgingival curettage.<br>Home use of a spirocheticidal dentifrice. |
| 2 | The gingivae give no constant clinical picture.<br>Roentgenograms show a complete destruction of the coronal bone associated with some interstitial osseous disintegration.<br>Calculus present. (Fig. 6.) | Elimination of predisposing causes (local and general).<br>Thorough prophylaxis.<br>Nonradical surgery associated with subgingival curettage.<br>Specific home treatment.<br>Use a spirocheticidal dentifrice as soon as the tissue will tolerate toothbrush. |
| 3 | Gingivae may have a slight sunken appearance with bluish margins.<br>Mucoid exudate present.<br>Calculus present.<br>Roentgenograms show a complete destruction of the coronal bone associated with pronounced interstitial osseous disintegration.<br>Destruction involving the region of the root bifurcations and beyond. (Fig. 7.) | Treatment of these cases should be attempted only by specialists.<br>Extraction is usually indicated but only after thorough prophylaxis and a course of specific treatment. |

Fig. 1 C—Vertical destruction. (Courtesy of Doctor A. W. Bryan, State University of Iowa, College of Dentistry.)

**TABLE 3—Pocket Formation with Vertical Destruction (Fig. 1,C).**

| Type | Pathologic Manifestations | Treatment |
|---|---|---|
| 1 | Very little change in the appearance of the gingivae.<br>Slight exudate present.<br>Calculus present.<br>Roentgenograms show a definite change (pathologic) in the periodontal membrane. (Fig. 8.)  | Elimination of predisposing causes (local and general).<br>Thorough prophylaxis.<br>Subgingival curettage.<br>Home use of a spirocheticidal dentifrice. |
| 2 | Very little change in the appearance of the gingivae.<br>Usually a slight recession.<br>Mucopurulent exudate present.<br>Roentgenograms show a pronounced destruction of periodontal membrane.<br>The interdental bone has lost some of its vertical height, but the coronal portion may not necessarily be destroyed.(Fig.9.)  | Elimination of predisposing causes (local and general).<br>Nonradical surgery associated with subgingival curettage will prove successful.<br>Specific home care (mouth wash).<br>Use spirocheticidal dentifrice as soon as gingival tissue will tolerate the toothbrush. |
| 3 | Some gingival recession.<br>Usually the gingivae between the teeth have a decided sunken appearance with the edges being a grayish blue.<br>Copious mucopurulent exudate present.<br>Roentgenograms show a destruction of the periodontal membrane well toward the apical region.<br>Calculus present. | This condition may usually be regarded as incurable.<br>Treatment should be attempted only by a specialist.<br>Extraction is usually indicated, preceded by a thorough prophylaxis and a course of specific therapy. |

formulated strictly for professional use. They should never be placed in the patient's hands. In order to secure the most rapid destruction of the fusospirochetes, it is necessary that professional attention be assisted by a satisfactory home treatment. To that end the patient is supplied with a 10 per cent solution of either prescription 1 or 2 and instructed to rinse his mouth carefully with the solution twice a day. If prescription 2 is used, it must be labeled "poison" and the patient cautioned against swallowing it. When the acute symptoms have subsided sufficiently for the gingivae to tolerate brushing, the patient is supplied with a bismuth-bearing dentifrice and instructed to use it as he would any ordinary tooth paste.

*Acute Gingivitis*—In the acute cases of specific gingivitis and Vincent's infection the medicament is topically applied, once a day, into the interproximal spaces, the gingival sulci and all other questionable areas. Prescription 1 or 2 is used and is applied with saturated cotton applicators or by means of a spray. In addition the patient is supplied with a 10 per cent solution of the same reagent for home use and instructed to rinse his mouth with it twice a day. During the acute stages the toothbrush should not be used. Three days are usually sufficient to effect a symptomatic cure.

*Chronic Gingivitis*—In view of the fact that the modern concept of this disease has so completely revolutionized therapeutic procedures, its various chronic pathologic manifestations and the appropriate treatment are presented here in some detail. For treatment purposes the chronic gingivitides can be divided into three groups: (1) periodontal disease without pocket formation (Fig. 1, A); (2) pocket formation with horizontal destruction (Fig. 1, B); (3) pocket formation with vertical destruction (Fig. 1, C).

The accompanying tables are presented mainly as a guide for the recognition and treatment of the various manifestations of chronic fusospirochetal disease. The operator should not lose sight of the fact that each case must be individualized.

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## FEDERAL BUREAU SEEKS IDENTIFICATION AID*

The Federal Bureau of Investigation, United States Department of Justice, requests the cooperation of the dental profession in apprehending Merton Ward Goodrich who is wanted for murder in Detroit, Michigan.

His description is as follows:

Age, 25, (born May 7 or 8, 1909 at Ona, West Virginia); height, 5 feet 10½ inches; weight, 120 pounds; build, slender; hair, thin, light brown, slightly bald-front; eyes, dark hazel, protruding, dark circles beneath; complexion, sallow; ears, prominent and protruding; *teeth, lower teeth dirty, four teeth in front of large discolored tooth in upper left jaw missing, black stubs in right upper jaw*: scars, slight scar on right cheek; occupation, piano player and trap drummer, magazine salesman, radiotrician; pecularities, shuffling walk with head down, apparently tuberculous and a heavy drinker.

In the event any information relative to any person answering the above description is secured, kindly notify the nearest office of the Federal Bureau of Investigation by telephone or telegraph collect.

*EDITOR'S NOTE: Criminal Goodrich was apprehended in New York on July third.

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## LETTER TO THE EDITOR

The letter by Doctor Fleetwood[1] of Seattle in reference to the illustrated book for Patient Education was of great interest to me. For several years I have been in charge of the dental department of our public schools. Until the last year my lectures to the children were given without accompanying pictorial support.

When I received the booklet with my subscription to THE DENTAL DIGEST you may well see that I realized the benefit the charts would be in presenting the subject matter to the children.

After the first lecture I was repaid by the teacher's remark that the pictures made the points much clearer than at former times.

The point is well brought out in the last number of ORAL HYGIENE, May, 1935, by the article, WHAT I'D LIKE MY DENTIST TO TELL ME by Doctor Frank H. Richardson.

Will the material on the subject of Patient Education which has been published this year be put in pamphlet form also?

There is no more effective education than that which is presented in visual form. May we have much more that will be available at an early date. May I express my appreciation of the contribution THE DENTAL DIGEST has made to this field of work?—O. B. HOOD D.D.S. School Dentist, *Virginia, Minnesota.*

The second series of charts, THE EDUCATION OF THE DENTAL PATIENT, will be published in booklet form as soon as the series is completed.—EDITOR.

[1]Fleetwood, C. T.: Illustrated Book for Patient Education, Letters to the Editor, 41:131 (April) 1935.

# A DIAGNOSTIC ROOM

M. A. DENBY, D.M.D.
Warren, Rhode Island

WHAT is the average practitioner doing to further his practice and spread the gospel of preventive dentistry? He should be teaching or explaining the principles of simple or complex dentistry. To this end, I decided to build a diagnostic department conveniently located and equipped for any type of dental examination. As the department developed, so did the possibilities for a new idea in dental education.

I discovered a diagnostic cabinet, shown in the accompanying illustration, which could be built into a partition of the room. The cabinet was furnished with six opaque glasses with indirect lighting behind to be used in explaining dental conditions (Visualette). The indirect lighting is not sufficient for operating work, however.

The next problem was to find a way to portray these conditions intelligently to the patient. The idea of painting common dental conditions seemed good; also a hunt was made for clear pictures of these conditions. The charts, THE EDUCATION OF THE DENTAL PATIENT, published in this magazine proved helpful. A hospital artist was employed and six paintings depicting the most common dental conditions were done from these charts.

A diagnostic room

These pictures simply and briefly explain dental conditions to patients in a manner which they can readily understand because they *see* the conditions.

A dark room which permits transillumination makes it possible to use films and the "Visualette" to educate the patient. The room has one window with good light for operative work, but the light can be shut out with black velour curtains for transillumination.

It has been interesting to observe the old-timer scoff at the suggestion of full mouth roentgenograms and then, after a few minutes of explanation of the roentgenogram flashed on the screen, change his ideas completely. The screen for this purpose as attached above the diagnostic cabinet and can be seen easily by the patient in the chair.

Other possibilities for this room have arisen. In the cabinet behind the glass door are actual models of all types of dentistry from the lowly gold crowns to the fascinating porcelain bridgework. After dental conditions are explained to the patient, it is simple to demonstrate by model what types of restorations are proper and necessary for the individual case. This procedure saves time and often provides an opportunity to make a better type of restoration.

Although the room was originally designed for education and diagnostic purposes, a small cabinet for instruments, spray bottles, and a cuspidor were added to take care of the occasional patient who drops in for an extraction or denture adjustment. The diagnostic room has been a worth while investment. The patients who use it for purposes other than diagnosis usually become interested and ask questions about the pictures.

[1]The first series of eight charts has been published in booklet form. The charts first appeared in February, March, April, May, June, October, December, 1933, and April, 1934, in THE DENTAL DIGEST. The charts of the second series have appeared in this magazine in July, October, November, December, 1934, and January, March, May, July, 1935. One more chart is to be published before this series is produced in a separate booklet.

7 Washington Street.

# DENTAL MODEL SURVEYING*

N. G. WILLS, D.D.S
Connersville, Indiana

THE construction of large, removable dental castings is comparatively new in dentistry; the dental colleges have not yet established comprehensive courses of study in this science. The Curriculum Survey Committee on Dental Prosthesis for the American Association of Dental Schools has recommended an outline for a course of instruction including Partial Removable Cast Dentures.

## Development of Partial Dentures

The steps of progress relating to the improvements made in partial dentures are within the memory of any member of the dental profession having practiced thirty-five years or longer. The first partial dentures were made from a beeswax impression; later, modeling compound or plaster. These partial dentures were made of vulcanite without any kind of metal clasp attachment. I have seen some in which a vulcanite clasp was used for retention.

The next improvement was a vulcanite partial denture retained by a metal clasp; then came the improvement of an occlusal rest. As partials became more commonly used, disadvantages began to appear as shown by their destructive action on oral tissues and tooth enamel.

A determined effort was made by the profession to overcome the disadvantages as they developed and this effort is being continued. After the wide destructive clasp, the wrought clasp was developed and in succession, the ready-made clasp and the cast gold clasp. In each successive development the clasp and bars used became smaller, more delicate, and more accurate. Improved alloys and investments were provided to facilitate this work.

In the early stages of the history of partial dentures clasps and bars were assembled in various forms until the one-piece casting was introduced.

We are now demanding still more accuracy in these partial dentures, stimulated by the complaints of patients who have to wear these appliances. To gain the accuracy that we strive to attain, I recommend to the profession further study of dental model surveying.

The mechanics of the construction of large, removable dental gold castings have been worked out to a fine point. We have definite knowledge as to what is going to happen. At no stage of the casting process are we worried about the outcome. The design of the case remains the only major problem in removable dental gold castings.

## Requirements of Design

1. A successful casting should be properly designed to prevent undue strain upon the remaining teeth.
2. The design must be sightly in appearance.
3. The casting should be free from food traps.
4. It must go into position and be removable without difficulty.
5. It must remain in a fixed or stable position during mastication.
6. The casting must be properly tempered to insure long life.
7. The most important requirement of all is that the casting be comfortable.

## Undercuts

The first difficulties to overcome are the undesirable undercut areas present as a result of bell-crowned, protruding, irregular, or drifted teeth. The undercut areas on the mesial and distal surfaces are always present in some degree.

The idea of filling in these undercut regions is not new; but the survey technique, which *produces accuracy in establishing a vertical plane or angle common to all the teeth involved in the casting,* may be new.

Since it is impossible for the human eye accurately to aline the different irregular and undercut surfaces to a common plane, it becomes necessary to use an instrument for the purpose.

## Construction of Surveyor

The surveyor I have designed (Figs. 2 and 3) is simple: It has a main or stationary base; number 6 in Fig. 2, upon which is placed a movable base, number 19. Upon this movable base is placed a generous amount of ordinary modeling clay, number 21, which has been made plastic by kneading glycerin into it. Upon this clay is placed the *master model* (Fig. 3), teeth upward, and parallel to the surface of the main base. By loosening the thumb-screw, number 15, the surveying tool, number 14, is released to move freely up or down and to turn without resistance within the sleeve, number 13. The working tools, numbers 17 and 18, are used in the chuck, number 16, for paralleling the mesial and distal, or any undercut surface. The tools are also used for scribing lines upon the teeth to show the positions on which the clasp should be placed.

## Master Model

We first secure a perfect master model of the case. The success of the technique depends greatly on this perfect master model; a faulty model which has been corrected will not serve. All locations in the impression must be so perfect that no manipulation of the poured model will be necessary.

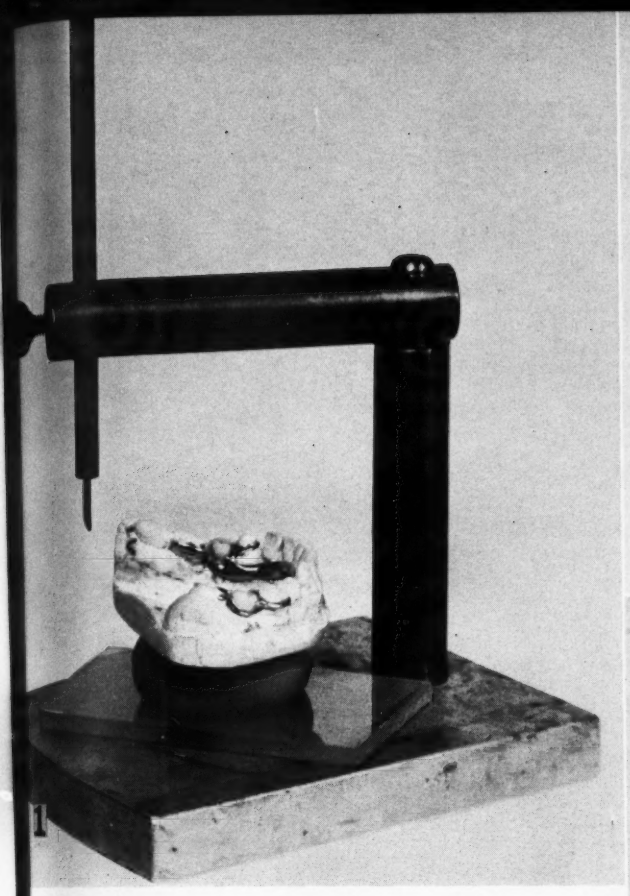
Because of the difficulty of securing an exact reproduction of the mouth in any of the plasters (small fractures in the embrasures invariably occur) as well as for the comfort of the patient, one of the hydrocolloid impression materials should be used. To save time, material, and patience, the impression should be taken in the water-cooled impression trays.

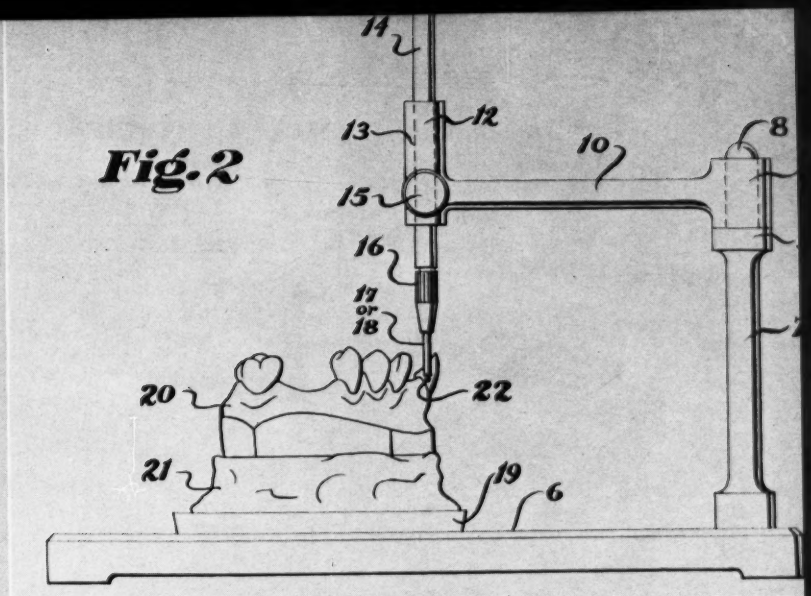
## Surveying Technique

1. *Establishment of Vertical Angle*—A definitely known vertical angle which is thought most suitable for the case, is established between the master model and the main base of the surveyor.

2. *Tripoding*—This is another step of great importance in this technique. It registers the vertical angle used. It is the position in which all undesirable undercuts are removed. It allows marking to be made so

*The assistance of Doctor F. E. Roach of Chicago is gratefully acknowledged.



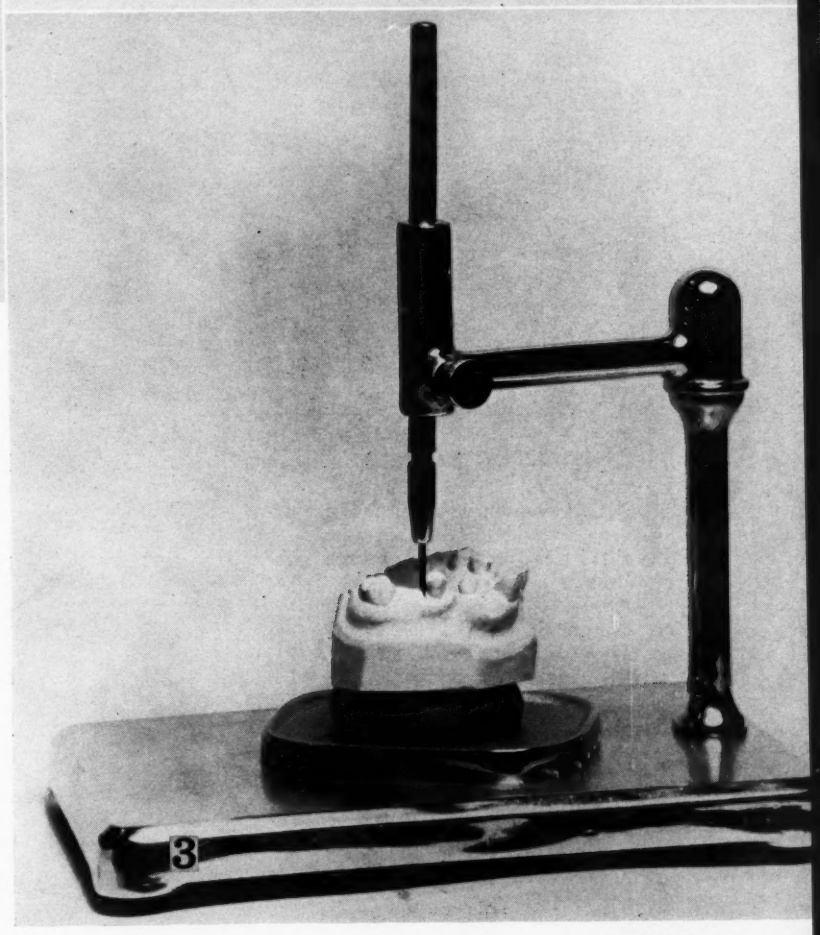




Fig. 1—Photograph of author's first surveyor.

Fig. 2—Improved surveyor, showing different parts numbered for descriptive purposes.

Fig. 3—Present dental model surveyor showing a master model in position and ready for study. The working tool is touching the disto-buccal vertical angle of the second bicuspid, locating an undercut, which would prevent placement of a removable denture, if the tooth were unprepared for its reception. The model is in an arbitrary position. The vertical sides of the steel working tool will be placed against each surface of the teeth to be clasped and the model will be manipulated for the selection of the most suitable vertical angle to be used in surveying and designing the case.

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that the duplicated casting model may be placed upon the surveyor in the exact position as was the original model (master model).

Tripoding is done in the following manner:

A. Three points: To establish a known and registered vertical angle to the main base of the surveyor, three widely separated points must be used: first, any point near the median line (Fig. 4); second, on the right side of the model near or posterior to the molar region (Fig. 5); third, a like position on the left side of the model (Fig. 6).

Before these three points are definitely established, a study of the model must be made to determine the most suitable angle to be used.

B. Position of the Clasp: With the model pressed firmly against the soft clay, lower the surveying tool, fitted with the steel working tool (beveled end down), so that the vertical side of the tool will contact the labial, buccal, or lingual surfaces of the teeth to be clasped (Fig. 3). The point of contact will predetermine the position of the clasp on that tooth.

By manipulating the position of the master model, different points of contacts with the tool against the teeth to be clasped can be studied to determine the most suitable clasp position.

Fig. 4—Tip end of working tool on surveyor, touching anterior point of tripod.

Fig. 5—Tip of working tool touching the right posterior point of tripod.

Fig. 6—Tool tip touching the left posterior point of tripod.

The three tripod points are not registered until after the most desirable vertical angle has been determined.

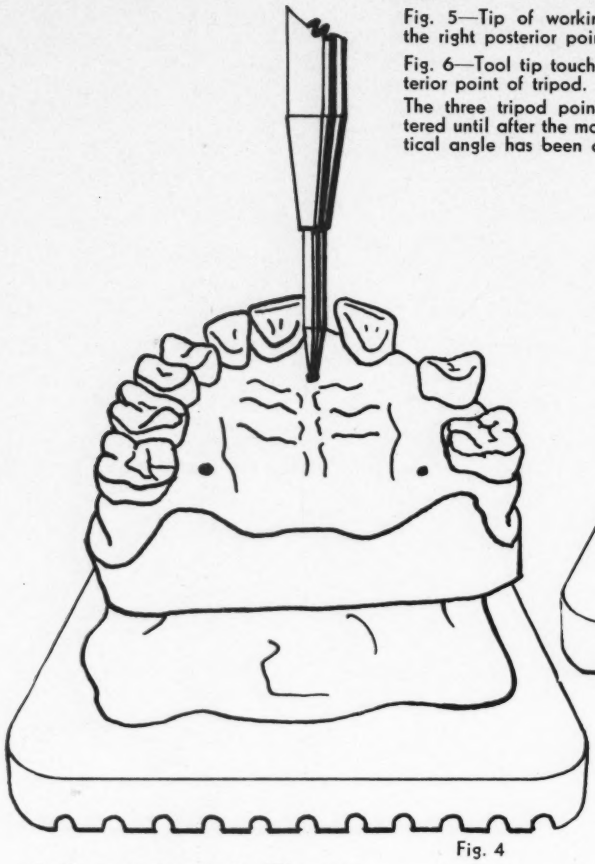


Fig. 4

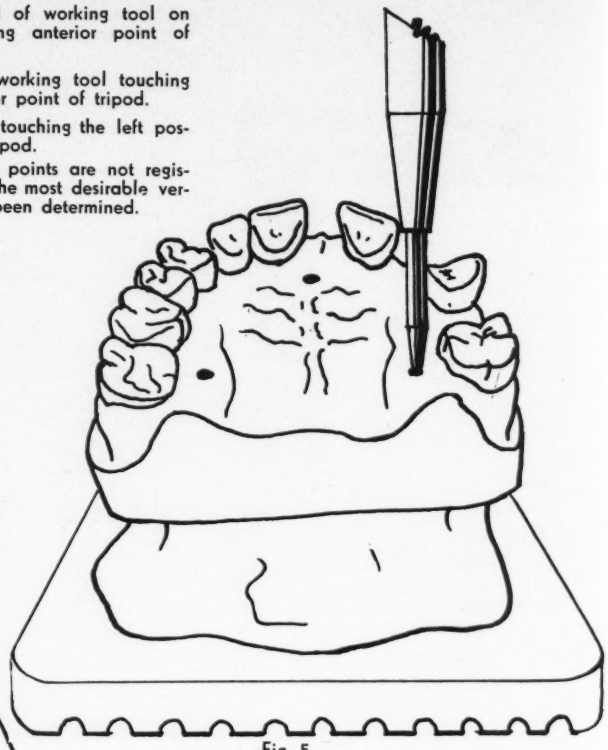


Fig. 5

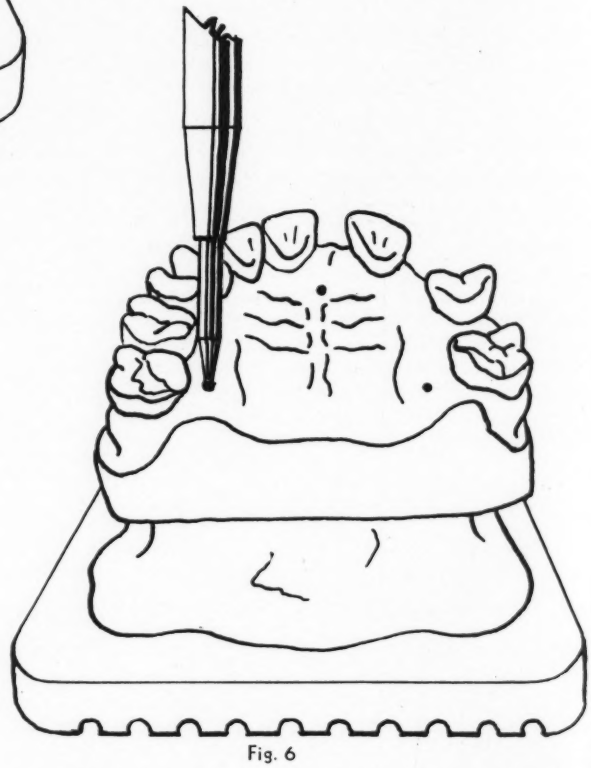


Fig. 6

C. Compromise Angle: The anterior and prominently irregular or tilted teeth present the greatest problems and must be favored. Sometimes it will be necessary to reach a compromise angle (Figs. 7 and 8) so as to favor two or more teeth. A little experience will help determine the best angle to use. If the anterior teeth are protruding and are to be used for clasps, it will be necessary to tilt the model to a decided angle by raising the anterior and lowering the posterior teeth upon the clay. The higher the anterior portion of the model is raised, the higher the position of the clasp will be upon the protruding labial surfaces. This may cause another compromise angle.

D. Path of Insertion: The angle decided upon will be the one used in placing the casting in the mouth; this is known as *the path of insertion.*

E. Stabilizing Master Model: When satisfied with the established vertical angle to the model, seal the model to the mass of clay by flowing melted base wax at their junction; thereby the master model is stabilized for the subsequent operations.

F. Establishing Temporary Point of Tripod: Reverse the working tool (tapered end down). With the lock nut still loose, select a temporary point at the median line (Fig. 4). Lower the working tool so that the point touches the model at that location. Lock the surveying tool-holder in rigid position with the lock nut. The point of contact between the tip of the working tool and the model will establish the temporary point (anterior) of the tripod.

G. Permanent Points: Maintain-

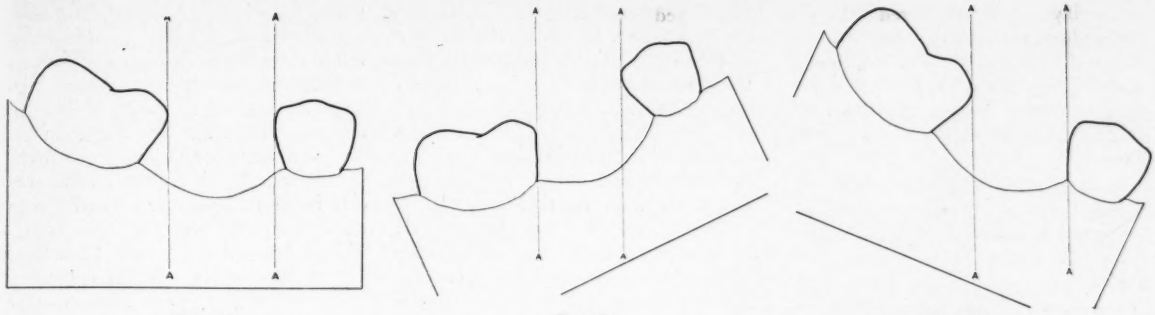


Fig. 7A Fig. 7B Fig. 7C

Figs. 7A, 7B, 7C—How different vertical angles may be selected on the mesial and distal surfaces on the same model, by simply manipulating the model on the clay base on the movable base of the surveyor.

Lines A-A are drawn vertical to the base of the surveyor.

Fig. 7A—Proper angle to use in this case. The molar tooth is inclined to the mesial, producing a decided undercut. The distal surface of the bicuspid has only a slight undercut surface. It is advisable to compromise these undercut areas by changing the position of the master model upon the clay base.

This can be better explained by the drawings 7B and 7C. In Fig. 7B, if the model should be raised as indicated, all the undercut surface of the molar would be eliminated, but notice what would happen to the distal surface of the bicuspid: a pronounced undercut would be created on that surface.

In Fig. 7C, should the model be placed upon the surveyor as shown, the slight undercut on the distal surface would be taken away and added to the mesial surface of the molar.

ing this rigid position of the working tool, swing the surveying arm to the posterior region on the right side of the model (Fig. 5) to see at what point the tool will touch; and again, swing to the left to touch the model. (Fig. 6). If the latter two points touch the model at a point suitable for placing an ink dot, the temporary or imaginary points may be used as permanent. These points are designated and registered by placing an ink dot at the three points of contact.

*The three points are then equally distant from the surface of the main base of the surveyor, and the vertical axis of the tripod is vertical to the main base and parallel to the axis of the tool-holder and the tools.*

The desirable vertical angle for the model is established; from this the casting is constructed. The three points established will be used again to tripod the casting model.

3. *Eliminating Undercuts*—With the master model in position the mesial and distal undesirable undercuts are determined, filled with modeling clay, and paralleled by means of the steel tool (Fig. 9). This is easily accomplished by loosening the thumb screw and lowering the surveying tool, sliding the movable base upon the surface of the main base, and by swinging the surveying arm and its tool from side to side in order to reach all points of the teeth to be clasped.

4. *Duplicate Casting Model*—After the undesirable undercut areas of the master model are paralleled,

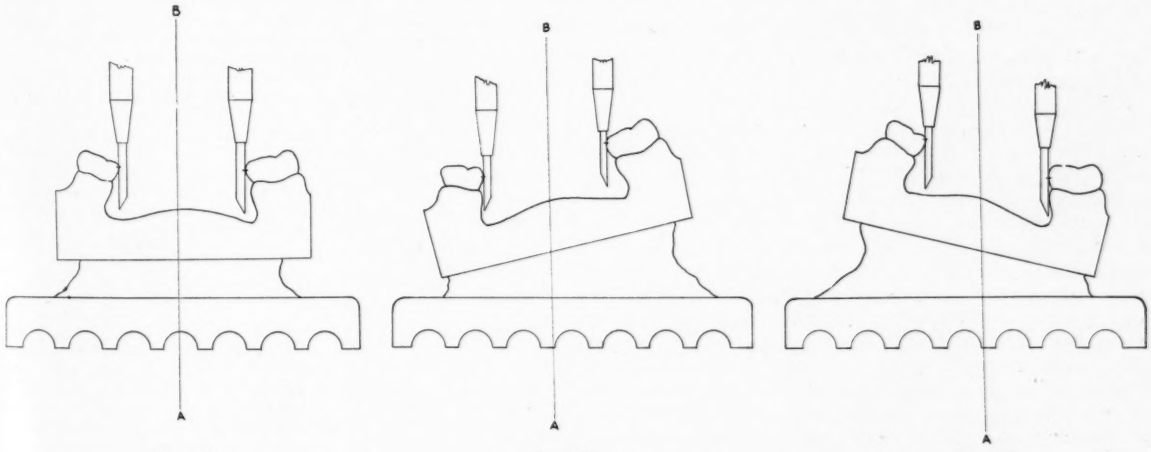


Fig. 8A Fig. 83 Fig. 8C

Fig. 8A, 8B, 8C—How the buccal and lingual vertical angles may be compromised for unilateral castings. Position of clasps for a bilateral case.

Lines A-B are shown vertical to the main base of the surveyor.

In Fig. 8A, if a bilateral casting were to be made for this case, the positions of the molar clasps would be on or near the lingual-occlusal line angles, depending on the degree of lingual inclination of these teeth.

If it is possible to make unilateral cases, the clasps may be lowered on the lingual surface of the molar teeth by tilting the model as shown in Fig. 8B and 8C, as described under Fig. 7B and 7C.

the model is removed from the clay and a duplicate casting model is made therefrom (Fig. 10). The duplicated model (Fig. 11) is the same in every respect as the master model except that the undesirable undercuts are not present.

5. *Separating Model from Duplicating Material*—The surveyed master model is smeared evenly with cocoa-butter and placed upon a glass slab 4½ by 4½ inches (Fig. 10), (teeth upward). By doing this the model will readily separate from the poured hydrocolloid material which is used for duplicating.

6. *Preparation of Casting Model*—(a) A split brass ring (Fig. 10) 3¼ inches in diameter and 1¾ inches in height is placed over the surveyed master model. (b) A mixture of any of the colloid materials thinned to three-fourths material and one-fourth water is heated and allowed to boil. (c) Stir or vibrate until the air bubbles are eliminated.

(d) If the three tripod points on the master model are touched with an indelible lead point, just before the pouring process, the points will be transferred and shown on the casting model. (e) After cooling slightly, pour the solution over the prepared and surveyed master model. Fill the ring a little more than full. (f) Now another piece of the glass of the same size is laid upon the poured material. Any surplus material will overflow to the outside of the ring. (g) By holding the two pieces of glass the ring may be immediately plunged into cold water, thereby shortening the cooling period considerably. (h) Remove the master model after cooling and pour the duplicating impression in casting investment material.

The surveying technique may be used in the construction of partial removable vulcanite dentures. The steps are the same as for a metal casting up to the point of duplicating the surveyed master model. For a vulcanite denture the duplicating impression is poured in model stone. The technique is continued to the waxing stage. Temporary partial removable vulcanite dentures may be made without any clasp attachment. Permanent partial removable vulcanite dentures may be made with any of the approved or wrought cast clasps for retention. The carbon lines upon the vulcanizing model assist in the placement of the clasps.

7. *Casting Model Survey (Tripoding)*—(a) When the casting model has been prepared and partly dried, place upon the modeling clay upon the movable base of the surveyor (Fig. 11). (b) The three tripod points transferred upon this model are now used to place the casting model in the same vertical angle that was used when the undesirable undercuts were removed in the original master model survey. (c) With the working tool fixed in rigid position, the three tripod points are brought in contact with its tapered end.

A little practice will permit this to be rapidly done. (d) When the points are established, the casting model is ready to be sealed to the modeling clay by melted base-plate wax. (e) At this stage, the carbon tool is placed in the chuck, beveled end down. (f) By releasing the surveying tool, allowing free motion, the vertical sides of this tool are used to scribe and mark lines upon the teeth to be clasped (Fig. 11). These lines are to be used for placing the wax clasps, and they designate the greatest diameters of the teeth when in parallel relationship.

This completes the surveying process.

(g) The waxing technique is the same as for any other system, with few exceptions (Fig. 12).

## Differences Between Surveyed and Conventional and Bar Type Clasps

1. Other techniques employ a narrow strap portion clasp. The strap is that part of a clasp upon the mesial and distal surfaces, including the occlusal rest. It has always been made narrow bucco lingually to keep away from the mesial, distal, buccal, and lingual vertical angles. This is the food trap area (Fig. 13); only the accuracy of surveying will allow these regions to be covered or bridged adequately (Figs. 14 and 15).

2. The conventional clasp wings start at the strap; are fashioned to go directly to the labial, buccal, or lingual surfaces; they allow for a loose-fitting clasp at the vertical angles and continue this looseness to the tip of the clasp. The clasp requires comparatively frail construction to allow for springing into position. The spring begins at the strap.

3. The bar clasp leaves the strap portion on the mesial and distal surfaces, skirts around the vertical angle, and returns to contact the tooth at some undercut point.

4. In the square or thick-necked type teeth, the spaces at the mesial and distal surfaces left uncovered cause food packing only to a slight degree. In bell-crowned, irregular or drifted teeth, the open spaces cause food traps that are distressing (Fig. 13).

5. What happens when the surveyed clasp is used? When the undercut surfaces are filled in, the paralleling must be carried beyond the vertical angles and on to the labial, buccal, and lingual surfaces, if the undercuts carry that far. These undercuts are entirely eliminated when the casting model is made. Wherever clay is shown upon the surveyed master model, the undercut area (Fig. 9), the strap portion must be carried far enough in the waxing technique (Fig. 12) slightly more than to cover the undercut shown by the clay. The distance depends on the undercut area. In badly tilted teeth this strap portion may reach as far as midway

Fig. 9—Master model. The most suitable vertical angle for the model has been determined; the undesirable undercuts have been filled with modeling clay and scribed with the working tool of the surveyor; all undesirable undercut areas placed in one common plane. Note area at disto-buccal vertical angle of the left second bicuspid, which is not filled with clay. This natural undercut is to be used later for the placement of a modified Roach I bar for retention.

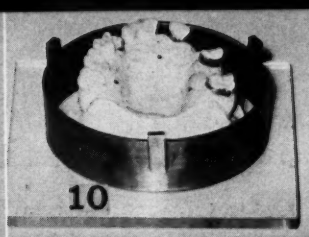
Two points of the tripod may be seen on the palatal surface of the model. The instrument is touching the right posterior and the anterior point is in the region of the median line.

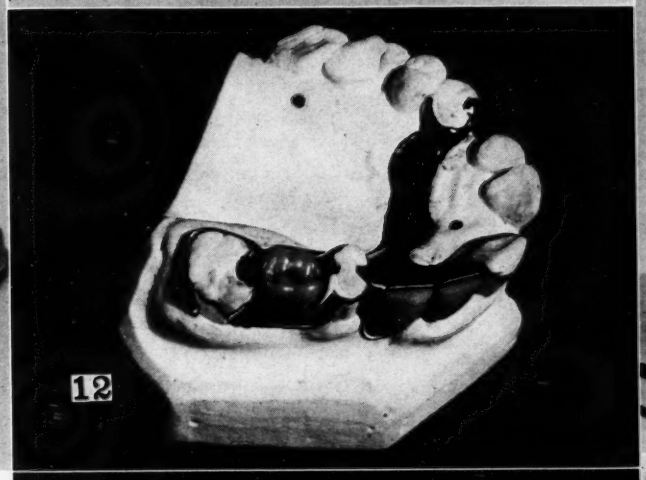
Fig. 10—Technique for duplicating a surveyed and tripoded master model. The shaded locations on the teeth show the molding clay, which has been circumscribed with the working tool of the surveyor, placing all surfaces of the teeth requiring clasps in one common vertical angle. The three black dots in the palate of the model are the tripod points, recording the vertical angle used in circumscribing the teeth. These tripod points will be transposed on the duplicated casting model.

On the left, the master model, in position on a piece of plate glass, in the lower half of the duplicating ring. To the right is the upper half with a piece of plate glass showing its position after the hydrocolloid mixture has been poured into the full ring. By this process a perfect reproduction of the surveyed master model is obtained in casting investment.

Fig. 11—Same master model shown in Figs. 3, 4, 5, 6, 9, and 10. It has been duplicated in casting investment from the master model as shown in Fig. 10. It is shown tripoded in the original recorded position and carbon markings have been circumscribed on the teeth, showing the greatest diameters of the teeth to be clasped.

Clasps placed on or slightly below these lines (the length of the clasp wing will suggest the proper wax clasp position), will glide into position without producing strain on the teeth. There will be little clasp wing spread to cause future crystallization of the metal, and a minimum of grinding will be necessary to secure a comfortable fitting denture.





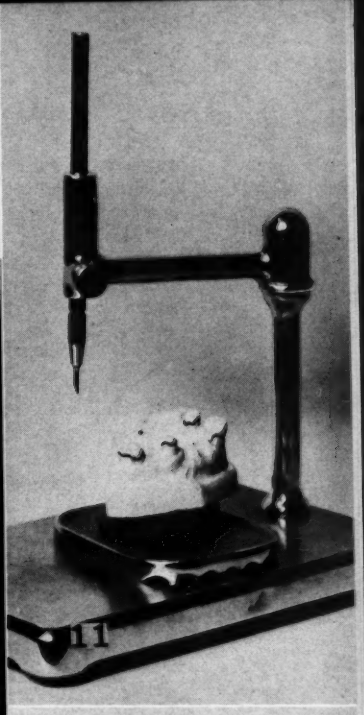


Fig. 12—Case waxed and completed up to the stage of the casting process, upon the duplicated and resurveyed casting model. Note the absence of food traps, all clasps are properly reciprocated; the labial wing on the left central, and the buccal wing on the second bicuspid and second molar have been eliminated.

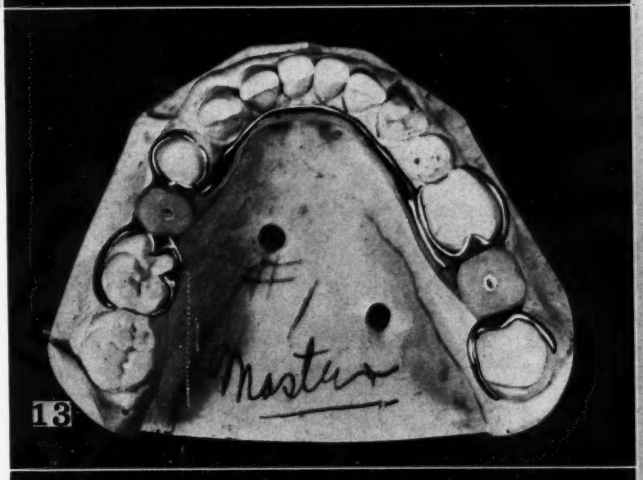



Fig. 13—Casting shown in Fig. 1. This casting was surveyed on my first surveyor, before waxing. It has all the old style disadvantages of an ordinary casting, except placement, because the clasp positions were circumscribed and the wax clasps placed thereon; the case glided into position nicely and without the necessity of grinding any metal at the mesial and distal undercut surfaces. Because it was made as a bilateral case, with the teeth inclined to the lingual and because it drifted mesially, the clasps upon the left second molar and right first molar (lingual wings) came near or on the lingual-occlusal line angle.

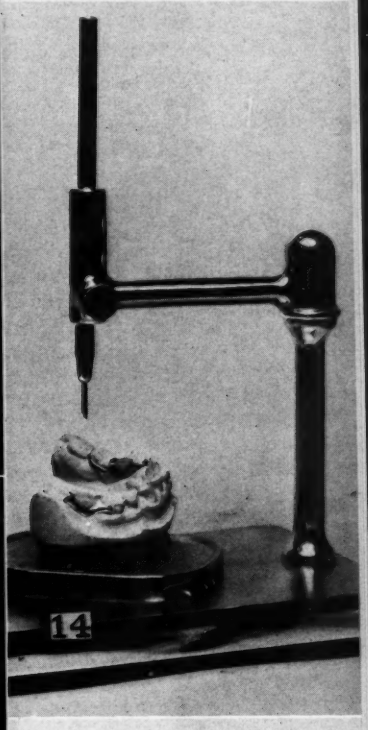


Fig. 14—The same master model as shown in Figs. 1 and 13. It is shown as a comparison with Fig. 13. Unilateral castings have been made. Food traps have been eliminated. The left clasp molar inclined mesially and lingually, necessitating an extremely wide mesial clasp strap to bridge the space usually left open in other techniques.

The right unilateral casting shows the elimination of the buccal wings of those clasps, as well as the complete closing of the food trap areas at the bucco-mesial and distal vertical angles.


Fig. 15—Same master model shown in Figs. 1, 13, and 14. Elimination of lingual bar and saving in metal used.

Lingual and palatal bars should not be used, except in cases requiring balance or those with missing posterior teeth where it is desired to create tissue support.

The patient will appreciate the elimination of lingual and palatal bars if it is possible to do so.

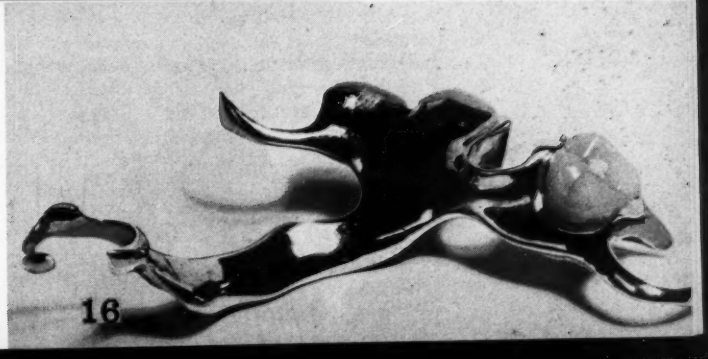


Fig. 16—Finished casting that has been carried through the steps of surveying technique.

between the mesial or distal surface, allowing for only a short arm or wing to complete the clasp. Only in this manner can all space between casting and tooth be covered or bridged to prevent the entrance of food.

### Retention of Surveyed Clasps May Be Controlled

When the casting model has been surveyed and positions of clasps scribed by carbon marking, retention may be controlled by the waxing technique.

The surveyed clasp is usually, or may be, a rigid clasp, allowing in some cases, only small amount of wing spring; therefore, if the strap is carried well on to the buccal, labial, or lingual surfaces, one cannot expect much wing spread, in placing the clasp upon the tooth. Should the waxing be done below the scribed carbon line, and there is a short wing, it would be impossible to place the clasp upon the tooth without excessive grinding. Such grinding would completely defeat the purpose of the technique.

If the surveying of the master model permits a long clasp wing, allowing for springing, the carbon line upon the tooth may be crossed in waxing. This will produce a clasp that will spring or snap into position.

The old idea of gripping a tooth with a clasp for retention has been so impressed on our minds that it is difficult to forget. The survey technique requires only a slight amount of retention. For that reason, I seldom attempt to place retention for a clasp at more than one point on a tooth. Other surfaces are used to reciprocate this slight amount of retention.

### Elimination of Buccal Wing on Bicuspid and Molar Clasps and Labial Wing on Cuspids

Survey clasps become automatically fixed and balanced. The accuracy attained permits, in many cases, the elimination of the greater portion of the buccal wing on bicuspid and molar clasps. It is this wing that is less tolerated by the buccal tissues than any other, especially the third molar.

If the clasp is carried just past the clay shown on the buccal surface (Figs. 12-14-15) of the master model, that is sufficient and becomes the point of reciprocation, retention being placed on the lingual wing.

It is necessary that only slightly more than 180 degrees of the tooth circumference be included in the clasp to prevent tooth movement.

Jemison Building.

## ADVANTAGES OF SURVEYED CLASPS IN CAST PARTIAL DENTURE CONSTRUCTION

1. No Guess work.
2. Position of clasps can be predetermined; thus giving most advantageous positions on any tooth or teeth desired.
3. Clasps glide into position instead of springing over prominent surfaces of the teeth.
4. Only slight amount of retention is necessary to hold casting in position.
5. Food traps can be reduced to a minimum.
6. Clasp teeth are comfortable even on first insertion of the case.
7. A survey casting does not produce tooth movement.
8. No provision is necessary to allow for settling of the case.
9. The same vertical plane or axis for removing undesirable undercuts is utilized for designing position of clasps.
10. Surveyed cases often permit unilateral construction instead of bilateral.
11. Surveyed cases help suggest their own design.
12. Surveyed clasps create a minimum of space between clasp and tooth on mesial and distal surfaces; just enough to allow casting to be placed in position and no more.
13. Strain upon clasp teeth is almost eliminated.
14. Retention, stabilization, fixation, and balance become automatic when clasps are surveyed.
15. The buccal wing, which is the most irritating, may be eliminated upon bicuspids and molars, and sometimes upon the labial of cuspids.
16. Metal in surveyed clasps is less likely to become fatigued to the point of fracture because of the slight degree of spring necessary for placement or removal.
17. Surveyed castings move only in two general directions: occluso-gingivally. The clasps fit the teeth in a sleevelike or telescoping manner. This accounts for the slight amount of retention necessary to retain them in position.

In the square or thick-necked type teeth a Roach I-Bar (Fig. 12, shown at the disto-buccal vertical angle of second bicuspid) may be used for retention on the mesial or disto-buccal vertical angle. This requires that the lingual wing act as reciprocation for this bar. In Fig. 15 showing a right unilateral casting, the short buccal wings are reciprocal clasps, retention being gained upon the lingual clasp wings.

The I or C bar, or a contact point at the disto-labial vertical angle of a cuspid tooth, will permit the elimination of a labial clasp wing on this tooth, if the required more than 180 degrees of the circumference of the tooth can be gained.

If a retaining point or bar is to be used, provision must be made for it at the time the undercut is being eliminated in the master model survey. The undercut is completely filled with clay and circumscribed with the working tool of the surveyor. Clay is removed at the exact spot at which the retentive point is desired.

Many of my clasp designs are modified Roach Bars. The surveyor tells me where to place these bars. It is not necessary to create food traps in using modified bars.

Inasmuch as only a slight amount of retention is needed to retain surveyed castings, due caution must be used in the indiscriminate grinding in finishing of the inner surface of the clasp. If properly constructed, it is seldom necessary to use pliers for any adjustment on a surveyed clasp; in fact, pliers will damage some of the fine points gained by surveying. Any adjustment of this type of clasp (should the clasp fit too tightly) may be corrected by slight grinding or polishing. If too much grinding has been done, it may be necessary to make another casting if manipulation with pliers does not help.

# RELATION OF CALCIUM METABOLISM TO THE ENDOCRINE GLANDS

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IN A large number of cases of dental abnormalities, such as alveolar resorption, bone atrophy, tissue hypertrophy, and gum retraction, there is an associated constitutional factor. By this statement I mean that after ruling out such factors as malocclusion, overbite, inferior protrusion, and gingival infection as causes of the dental abnormality in question, there remains in many cases a general body condition which appears to be playing the most important part in maintaining the abnormality. Such a condition may reasonably be regarded as some sort of chemical imbalance. By way of illustration, many investigators have called attention to the frequent association of so-called alveolar pyorrhea with diabetes, a constitutional disease. Similarly, ovarian and thyroid dysfunction have appeared in coexistence with alveolar bone resorption. Oversecretion of the pituitary gland is associated frequently with the condition of inferior protrusion. These three examples serve to indicate the importance of the endocrine glands in the regulation of body chemistry.

## The Endocrines

Endocrinology, or the study of the glands of internal secretion, is one of the newest fields in medicine. Already this branch of study is beginning to point the way toward the solution of some of our most vexing medical problems. Just what is known and proved in scientific endocrinology, and what is the nature of the endocrine system?

The endocrine, or internal-secreting glands include the following: the pituitary, situated in the head just between the ears; the thyroid, situated at the base of the neck; parathyroid, adjacent to the thyroid; the adrenal and the thymus glands; the pancreas; and the gonads or glands of reproduction. Just how these glands are related to one another is not known, but that some definite relationship exists can be clearly demonstrated. Removal or disturbance of one of these glands produces not only symptoms of disturbed function of that particular gland but also symptoms indicating a disturbance in the function of other glands of the endocrine system.

Certain abnormalities in growth and body configuration are associated with and can be definitely attributed to certain glandular irregularities. The stunted form of the cretin, the comparative measurements of the abnormally tall, the familiar form of the eunuch, the characteristics of the obese—each of these bears a definite and recognizable relation to a certain type of endocrine dysfunction, sometimes the dysfunction chiefly of one gland, sometimes of several.

Within the last few years investigators have noted considerable evidence pointing to a definite relation between glandular function and such hitherto unsolved problems as bone texture, tissue integrity, and resistance to infection. More specifically, I refer to calcium and phosphorus metabolism and their possible regulation by the glands of internal secretion.

## Calcium and Phosphorus Metabolism

*Function*—Calcium is an important factor in regulating the activities of the body. It is essential to all protoplasm; it is required for the action of ferment, and it retards inflammation by constricting the blood vessels and by diminishing the permeability of cell membranes. Calcium ions are necessary for the normal activities of all nerve and muscle tissue. Calcium phosphate and carbonate form the chief constituents of bones to which they give rigidity.

*Requirement*—An adult requires about 0.5 Gm. of calcium daily for normal metabolism, or roughly, the quantity present in a pint of milk; this is easily supplied by an average diet. It has, however, been shown in a publication by Sherman and Rose[1] that the diets of many people in America contain only the bare minimum of calcium required to balance excretion. If any condition of diminished absorption, increased excretion, or a greater demand for calcium by the tissues should arise, the supply would, therefore, be insufficient. It is known that such an increased demand may occur from time to time. Pregnancy is an example.

During the first four months of pregnancy the fetus requires only about .006 Gm. daily, a negligible amount. After the seventh month this increases about a hundred times, and at full term 0.6 Gm. per diem is required. This implies that during the last months of pregnancy the mother needs at least twice her normal supply of calcium. If sufficient calcium is not provided, it is withdrawn from the mother's bones to supply the fetus. The fact is familiar to dentists that the pregnant mother may develop soft and carious teeth during this period.

During the last two or three months of pregnancy, during labor, and in the first few weeks of lactation, the supply of calcium in the mother may become so apparently deficient that tetany ensues. Some investigators feel that the ensuing tetany is not produced by a deficiency of calcium, but by improper utilization of this element. They point out that profound hemorrhage in nonpregnant persons rarely produces tetany. Profound hemorrhage in pregnant women, however, is more apt to produce tetany or symptoms of calcium deficiency. It has been demonstrated in some of these latter cases that the tetany could be readily controlled by administration of parathormone and vitamin D. This indicates that the body was not actually depleted of calcium, but that there were storehouses not being utilized. (Englebach[2]).

This view is further substantiated by the well demonstrated fact that in osteomalacia (adult rickets) which occurs most commonly during pregnancy and in which the serum calcium is low (5-7 Mg. per cent), the administration of calcium salts alone does not relieve the condition. It is necessary to give vitamin D in order to bring about proper utilization. It is interesting to note that the bones of the fetus show no signs of rickets, but only rarefaction (osteoporasis).

Cantarow and Montgomery[3] have

[1]Sherman and Rose: Scientific Monthly, 37:442-447 (November) 1933.

[2]Englebach: Endocrine Medicine, volume 3.

[3]Cantarow and Montgomery: Internat. Clin. 1:34-36 (March) 1931.

stated that during the course of normal pregnancy there is a slight increase in diffusible calcium and a marked decrease in nondiffusible calcium. The ratio of diffusible to nondiffusible calcium increases steadily, reaching a maximum in the first stage of labor. They assert further that in cases of tetany and other toxemias of pregnancy, this ratio of diffusible to nondiffusible calcium is reversed, resulting in improper utilization.

Calcium accumulates in the body of the fetus, especially during the last weeks of gestation. If the child is born prematurely, this store is not persent. Hamilton[4] has recently shown that the ratio of the amount of calcium to the body weight decreases during the first four months in normal human infants. As the skeleton increases in proportion to the body weight, he considers that the child uses the store of calcium present at birth for skeletal development during its early life. The practical significance of these observations is that they may explain why premature infants invariably suffer from rickets and why normal infants rarely develop rickets before they are four months old; also, that abnormal caries and tetany in pregnant women cannot be relieved by administration of calcium salts alone if the factors for proper distribution and utilization are absent or deficient.

*Absorption Into Blood Stream*—This brings us to a consideration of the mechanism of absorption of calcium into the blood stream. The amount of calcium available for the body from the diet depends on absorption from the small intestine. The most important factors known to control this are the relative proportions of calcium, phosphorus, and fat present in the diet, the acidity of the intestinal contents, the quantity of vitamin D, and the thyroid and parathyroid secretions. An excess of phosphate in the diet decreases calcium absorption, since calcium unites with the phosphate to form an insoluble calcium phosphate.

In young animals, rickets may be produced by giving a diet above normal in calcium and phosphate content; this result is due to the formation of this insoluble salt. This lack of balance, however, between calcium and phosphate is not so serious in human beings as is lack of balance between fat and calcium in the diet. An excess of fat in the diet interferes with absorption of calcium. This is due to the formation of calcium soaps which are not absorbed but excreted. More specifically, when fat enters the intestine, it is broken down into fatty acids and glycerin. Calcium unites with the fatty acids and forms calcium soaps which are excreted in the stool. If free fatty acid were excreted, diarrhea would result. When an excess of fatty acid occurs, therefore, all available calcium is utilized for the formation of additional calcium soaps, and thus calcium, which would normally be absorbed into the blood stream, is excreted from the body.

Calcium is likewise not absorbed properly if the stomach is deficient in hydrochloric acid, since acid is necessary to break down the calcium salts. It is not absorbed properly from the small intestine when there is deficiency of vitamin D. This fact has been well demonstrated by Shelling[5] of Johns Hopkins University. Furthermore, there is decreased absorption in the case of hypothyroidism. The explanation is presumably that of lowered body metabolism.

*Parathyroids as Regulatory Mechanism*—What does calcium do after it reaches the blood stream? This phase of the problem is of more specific interest, because the disturbance with which the dental profession is most concerned has to do usually with the mechanism controlling the laying down or distribution of calcium. The normal calcium content of the blood


Fig. 1—Cretinism in smaller child. Children same age. This type always reveals delayed dentition and carious teeth.

Fig. 2—Case of multiple cystic adenomas of thyroid.

Fig. 3—The girl on the left is an anterior lobe pituitary deficiency type. She is the same age as her companion on the right, who is normal in size. This type, as a rule, has well arranged and hard teeth.

Fig. 4—Case of marked myxedema.

[4]Hamilton: Am. J. Dis. Child. 46.775-785 (October) 1933.

[5]Shelling: J. D. Res. 13:363-378 (October) 1933.

stream is from 9 to 11 milligrams per cent. This is sometimes referred to as "ionic" calcium and it tends to remain at this level under ordinary conditions.

That the *parathyroid glands are the chief regulatory mechanism in maintaining this level,* I believe all are agreed. We know that if these glands are removed the animal or human being will die within a few hours from tetanic convulsions. This tetany is accomplished by a rapid fall in blood calcium and a rise in blood phosphorus. Likewise injections of parathyroid extract will stop tetany and restore the calcium-phosphorus ratio.

It has also been observed that an excess of parathyroid hormone or hyperplasia of the parathyroid glands will increase the amount of free or nonionized calcium in the blood serum and a decalcification of the bones, particularly the long bones, of the body will take place. Erdheim[6] as early as 1911 showed that removal of the parathyroids in the rat produces faulty dentition, delays calcification of a callus, and impoverishes the body of lime salts.

The parathyroids function normally to help in the maintenance of calcium balance both of the blood serum and of the bones. Other factors, such as vitamins, operate to help in the same balancing mechanism.

*Viosterol*—Since the first preparation of viosterol in 1927, much work has been reported concerning its action on blood calcium. Jones and Rappaport[7] have demonstrated that by feeding concentrated solutions of viosterol or vitamin D and a diet normal in calcium, a pronounced hypercalcemia of the blood serum will result within two weeks. If the diet is calcium free, however, then feeding an excess of viosterol will cause little elevation of serum calcium. We see, then, that when an excess of parathyroid hormone exists in the body, calcium is mobilized in the blood serum at the expense of the bones; yet when such a parathyroid condition does not exist, an excess of viosterol will take little or no calcium from the bones. In the latter case, viosterol will mobilize whatever calcium may be contained in the food. Recently Hess[8] of New York has reported that the effect of viosterol in raising the serum calcium level was through the parathyroids. He found that in monkeys and dogs fed large doses of viosterol, the serum calcium level frequently rose to 13-16 milligrams per cent, or to a pronounced hypercalcemia. After removal of the parathyroids, however, large doses of viosterol failed to raise the calcium above the tetanic level. In the absence of the parathyroids, it is necessary to give a diet high in calcium and heavy doses of viosterol over a long period of time in order to prevent tetany.

*Hypervitaminosis*—It is interesting to note in passing the fairly recent work of Harris and Innes[9] at Cambridge University, England, in which they found that in hypervitaminosis or overdosage of viosterol (vitamin D) there is a marked overgrowth of cementum on the teeth, which extends to three or four times its normal thickness, shows much cellular proliferation, and invades the marrow space of the jawbone. In the long bones (femur and ribs) a densely calcified overgrowth appears at the growing end of the bone—in contrast with rickets. In other words, an excess of vitamin D stimulates osteogenesis. In the advanced stages of hypervitaminosis resorption is extensive, and the cortex of the shaft and other "compact" bone becomes spongy.

*Calcium Deposit and Vitamin C*—Aub and Salter[10] have recently demonstrated another factor in the regulation of the calcium content of bone. They have shown that calcium fails to be deposited in bone when the diet, though adequate in calcium, is deficient in vitamin C. The subsequent addition of vitamin C to such a diet allows calcium to be deposited readily in the bone.

*Hypercalcemic Bone*—In considering the problem of hypercalcemic bone, it seems probable that we are confronted with retention of calcium and phosphorous and with hypercalcification. Many investigators have demonstrated this retention after parathyroidectomy in dogs. In the course of these studies, it was noted that these parathyroidectomized animals were much more susceptible to viosterol or vitamin D calcification. After parathyroidectomy a dose of viosterol which ordinarily would not produce calcification in a normal animal in a given length of time, causes, within that time limit, calcification of the organs of the parathyroidectomized animals. The close relationship existing between hypoparathyroidism and abnormal calcification, such as occurs in Paget's disease, juvenile sclerosis, renal sclerosis, and otosclerosis, has been frequently pointed out. The association of a low serum calcium and a low calcium excretion in otosclerosis has been often observed by otologists. The occurrence of cataracts in parathyroid tetany in human beings and in experimental animals has been noted by many observers.

I might mention here that my studies in cooperation with certain members of the California dental profession and with Doctor Hermann Becks of the Hooper Research Foundation tend to show that in cases of marked alveolar resorption there is a striking coexistence of endocrine dysfunction, particularly hypothyroidism. Especially do these hypothyroid patients show a disturbance in the calcium-phosphorus ratio, usually in the direction of high serum calcium and low phosphorus.

## Conclusion

In general we may say that bone changes are dependent not on the amount of calcium and phosphorus in the body but on the factors necessary to maintain the calcium-phosphorus balance and the proper distribution of these two elements.

[6]Erdheim: Frnkf. Ztschr. F. Path., Wiesb. 7:175-230, 1911.
[7]Jones and Rappaport: J. Biol. Chem. 93:153-166 (September) 1932.
[8]Hess: J. Biol. Chem. 94:1-8 (November) 1931.
[9]Harris and Innes: Lancet, 2:614-617 (September) 1932.
[10]Aub and Salter: Arch. Path. 11:380-382 (March) 1931.

490 Post Street.

# STUDIES IN AMALGAM

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WHEN choosing an alloy perhaps the most important factors to be considered are: expansion, contraction, tensile strength, and crushing strength. Doctor Black in his textbook states that the expansion and contraction of an amalgam is governed by the metals contained in the alloy. Inasmuch as manufacturers use Doctor Black's formula in preparing the alloy, the dentist has only to choose a good standard alloy. The tensile and crushing strengths are controlled by the metals contained in the alloy and also by the manipulation. Recently the Bureau of Standards conducted tests of the various alloys on the market to determine the crushing strengths. They employed a definite technique: The proportions were taken from the factory specifications; alloy and mercury were mixed in a mortar and pestle for two minutes; rubbed in the palm of the hand, and packed in case hardened steel dies. These tests resulted in alloys of a higher grade being sold on the market today.

In our experiments we tried to find the relative crushing strength of amalgam restorations placed by the dentist in his daily practice. In order to obtain crushings which would establish the relative strength of an ordinary amalgam restoration, we prepared samples of the different alloys to be tested. If an alloy is to be tested, the proper place to do so is in an operating room. The mixes were made, therefore, in a dental office under ordinary room temperature. The process of preparing and mixing the materials was done under the same conditions that prevail in an average office. Six standard alloys were selected which were in general use. As each manufacturer produces shavings and filings, tests were made of samples of each. A sample bottle of each grade of alloy was obtained through the courtesy of the manufacturers. These were then exchanged with the supply houses for stock bottles of the same grades to make sure of untampered alloy. All the manufacturers produce a chemically pure mercury, so that no definite selection of mercury had to be made.

## Selection of Matrix

The selection of a suitable matrix for packing was difficult. The Bureau of Standards uses case hardened steel dies as molds for packing. This method is also employed by the manufacturer in preparing and testing alloys. We were able to obtain, through the courtesy of one of our manufacturers, the steel dies to use in some of our clinical work. This gave us an opportunity to study the construction and practicability of the dies.

In placing a compound restoration in the mouth the amalgam is packed against the dentine on one side and the band on the other. Both the dentine and the band have definite elasticity. It has been proved that normal healthy dentine is elastic; therefore in packing the restoration material in the cavity the dentine has movement. In choosing matrix material for retainers we are forced to use a thin flexible band material. In using this band material we are able to make a suitable matrix for the reception of the restoration. Here, again, we pack the amalgam against elastic material that gives with each stroke of the plugger.

Because of the foregoing factors, a band of a thin matrix material was chosen. The factory suggested our using a band one-fourth inch high and one-fourth inch in diameter to facilitate crushing. After the bands were packed they were slit and removed, leaving ingots of amalgam one-fourth inch high and one-fourth inch in diameter. These completed samples were allowed to set for five days and then submitted to be crushed. Each sample was placed in a small envelope, sealed, labeled, and properly indexed. After all the samples were made they were sent to one of the factories with duplicate envelopes enclosed. This was done in order to save the residue. As each sample was individually crushed the residue was collected and placed in the duplicate envelope with the crushing strength listed on the envelope. In this manner we were able to obtain, examine, and exhibit the residues. By submitting the samples through an index the factory was not able to find out what amalgam was being crushed.

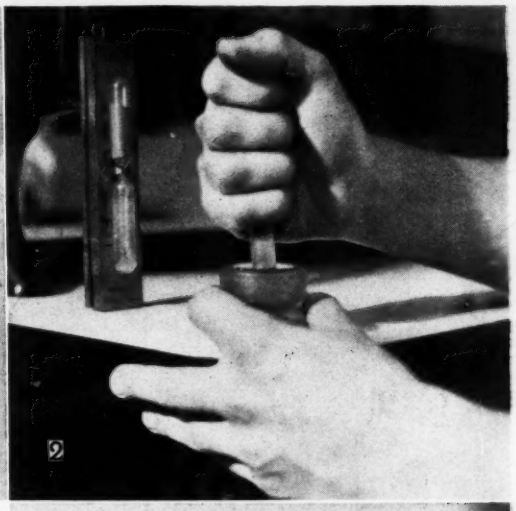
## Mixing

There are three methods of mixing alloy and mercury: by the palm of the hand, by mortar and pestle, and by an amalgamator. A sample of each grade of alloy was mixed in the three ways to try to determine which is the most practical for general use. The mixing time as used by the Bureau of Standards was set at two minutes. This time varied the least bit for the following reason: When the mixing was done in a mortar and pestle or an amalgamator the batch was rubbed into a ball in the palm of the hand and the excess mercury was expressed. By so doing the mixing time was increased to about two and one-half minutes. All the mixing was done with a sand glass for accurate timing.

## Packing

A technique of amalgam manipulation closely allied to mixing is that of packing. Because a good amalgam restoration must be properly packed and condensed, the packing technique is important. Amalgam must be packed and condensed thoroughly in the cavity before it assumes its initial set. It has been stated by manufacturers that amalgam can be mechanically packed for forty minutes provided the residue is kept plastic by the addition of mercury. This, however, is not a practical method to use in the mouth; we could not, therefore, employ the technique in our experiments. One can readily see that any alloy can have a great crushing strength by employing such a method for test packings. In the packing of these samples we adhered to no definite packing technique. A sloppy mix was used and condensed in the following manner:

The mix was divided into four parts. The first part was rubbed into the mold and condensed with a small plugger. As the alloy was packed to the base the excess mercury which rose to the surface was removed before the addition of more amalgam. Before each new part of amalgam



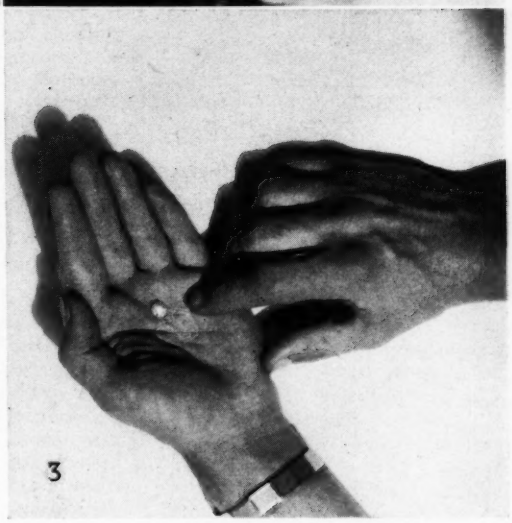


Fig. 1—Proper equipment for mixing alloy and mercury; alloy balance for proper proportions; mortar and pestle to mix with; sand glass for accurate timing.

Fig. 2—Correct position of mortar and pestle. Mortar should be laid flat on table or cabinet and held firmly with left hand. Pestle is held firmly in right hand with fist grip. Pestle is rotated in mortar with even circular motion. A constant pressure should be applied. When rotating the pestle should also rub the sides of the mortar to increase the mixing surface and assure complete amalgamation.

Fig. 3—Technique for mixing in the palm of the hand. Mix can be made with either thumb or forefinger. In preparing samples we alternated, using both fingers in making each mix. This method, although in common use some time ago, has proved to be the least advantageous at the present time.

was used, it was rubbed in the palm of the hand and the excess mercury was expressed. The last part was dry when placed in the mold, with the expression of all the mercury possible in order to produce a sample having a uniform density. A few samples were made of different alloys, poorly mixed, and packed with thumb pressure to determine the variation in crushing strengths. In mixing these samples the time was shortened; therefore the mix was stiff and coarse. This necessitated immediate handling and packing. Some good mixes were also packed with thumb pressure to determine the difference in crushing strength.

It will be noted in Table 1 that our crushing strengths vary greatly. The general average of the fine-cut alloys or filings seem to have a greater crushing strength than the coarse-cut alloys. We must not lose sight of the fact, however, that a coarse-cut alloy is more difficult to amalgamate and should the mixing technique of a coarse-cut alloy be modified to afford complete amalgamation there is no doubt that the crushing strength would be the same. This fact should be considered by manufacturers and be emphasized in each package of coarse-cut alloy.

The average crushing strengths of the alloys united in the mortar and pestle seem to be a little higher than those in the amalgamator and in the palm of the hand. Let us consider the different methods of mixing: When mixing in the palm of the hand, epithelial cells, oils of the skin, and perspiration are incorporated into the mix and the amalgamation will not be as complete as it is possible to obtain. As the quality of the restoration depends on the pureness and lack of contamination of the metals, the less the metals are rubbed in the palm of the hand the better. The only way to produce good, complete amalgamation is by trituration with pressure. This is produced the most satisfactorily in the mortar and pestle. The triturating, grinding motion rubs the alloy and mercury together in such a manner as to force complete union of the two, provided that enough pressure and motion are placed on the pestle for a long enough time. The fact that silver does not amalgamate readily makes it necessary to apply pressure when mixing; otherwise part of the silver will be held in suspension instead of being united in the amalgam. The mechanical mixer produces amalgamation by throwing the mercury and alloy together at a rapid pace. This does not produce complete amalgamation. In finely ground amalgam, however, it may be complete if enough time is given. When metals are thrown together at a rapid pace to produce amalgamation there is also danger of heat that would cause an initial expansion which cannot be overcome.

TABLE 1—First Experiments to Determine Crushing Strength

| Manufacturer | Type of Alloy | Method of Mix | Type of Mix | Type of Pack | Crushing Strength Lbs. Sq. In. |
|---|---|---|---|---|---|
| A | Coarse | Palm of hand | | Good | 25,750 |
| | Coarse | Mortar and Pestle | | Good | 41,750 |
| | Coarse | Amalgamator | | Good | 12,500 |
| | Fine | Mortar and Pestle | | Good | 53,000 |
| | Fine | Palm of hand | | Good | 42,500 |
| | Fine | Mortar and Pestle | | Good | 40,500 |
| | Coarse | Palm of hand | | Thumb | 25,000 |
| | Fine | Amalgamator | | Good | 11,250 |
| B | Filings | Palm of hand | | Good | 51,000 |
| | Filings | Mortar and Pestle | | Good | 52,000 |
| | Filings | Amalgamtor | | Good | 43,750 |
| | Shavings | Palm of hand | | Good | 44,500 |
| | Shavings | Mortar and Pestle | | Good | 33,000 |
| | Shavings | Amalgamator | | Good | 31,000 |
| | Shavings | Mortar and Pestle | Stiff | | 28,750 |
| C | Filings | Palm of hand | | Good | 29,500 |
| | Filings | Mortar and Pestle | | Good | 42,500 |
| | Filings | Amalgamator | | Good | 53,500 |
| D | Filings | Palm of hand | | Good | 34,500 |
| | Filings | Mortar and Pestle | | Good | 32,250 |
| | Filings | Amalgamator | | Good | 28,500 |
| | Shavings | Palm of hand | | Good | 12,500 |
| | Shavings | Mortar and Pestle | | Good | 26,500 |
| | Shavings | Amalgamator | | Good | 17,250 |
| | Filings | Palm of hand | Stiff | | 24,250 |
| | Filings | Mortar and Pestle | | Good | 35,750 |
| E | Fine Filings | Palm of hand | | Good | 43,500 |
| | Fine Filings | Mortar and Pestle | | Good | 45,000 |
| | Fine Filings | Amalgamator | | Good | 35,750 |
| | Shavings | Palm of hand | | Good | 9,250 |
| | Shavings | Mortar and Pestle | | Good | 29,250 |
| | Shavings | Amalgamator | | Good | 45,000 |
| | Coarse Filings | Palm of hand | | Good | 36,750 |
| | Coarse Filings | Mortar and Pestle | | Good | 22,500 |
| | Coarse Filings | Amalgamator | | Good | 51,000 |
| | Shavings | Mortar and Pestle | | Thumb | 6,750 |
| F | Filings | Palm of hand | | Good | 5,000 |
| | Filings | Mortar and Pestle | | Good | 40,000 |
| | Filings | Amalgamator | | Good | 57,500 |
| | Shavings | Palm of hand | | Good | 35,750 |
| | Shavings | Mortar and Pestle | | Good | 27,250 |
| | Shavings | Amalgamator | | Good | 28,250 |
| | Shavings | Mortar and Pestle | | Thumb | 25,000 |
| Mixture of all alloys | | Mortar and Pestle | | Thumb | 35,250 |
| Mixture of all alloys | | Mortar and Pestle | | Thumb | 25,750 |

SECOND EXPERIMENTS

As the Bureau of Standards requires all alloys put on the market to have a crushing strength of at least 35,000 pounds per square inch, our first results were not satisfactory. We conducted another series of experiments to try to obtain better results.

In this set of samples we used the same alloys but we confined ourselves to the filings, for the reason that they are the most generally used. We made three samples of each alloy. Each bottle of alloy contains a pamphlet giving explicit directions for handling the alloys. This is a specification required by the Bureau of Standards. The proportions, method, and time of mixing were closely followed as specified on these pamphlets. This was done because each manufacturer advocates employing a definite technique of manipulating his alloy so as to obtain maximum results. Every mix was made in a mortar and pestle as this method is advocated by the Bureau of Standards and by most of the manufacturers. The amalgams were packed and condensed in bands. It is interesting to note at this point that in following the proportions of some of the manufacturers the mix was not plastic enough to manipulate properly, and it was necessary to add more mercury when mixing. In one pamphlet no proportions were given at all. If we are going to use amalgam, these steps are essential in the successful placing of amalgam restorations, and we should demand these details. The samples were indexed and crushed as in the first experiments. The results varied as before with a low average of crushing strengths.

It will be noted in Table 2 that

TABLE 2—Second Experiments to Determine Crushing Strength

| Manufacturer | Type of Alloy | Method of Mix | Time | Crushing Strength Lbs. Sq. In. |
|---|---|---|---|---|
| A | Filings | Mortar and Pestle | As specified by factory | 21,400 |
| | Filings | Mortar and Pestle | As specified by factory | 31,400 |
| | Filings | Mortar and Pestle | As specified by factory | 18,600 |
| B | Filings | Mortar and Pestle | As specified by factory | 41,480 |
| | Filings | Mortar and Pestle | As specified by factory | 30,600 |
| | Filings | Mortar and Pestle | As specified by factory | 45,700 |
| C | Filings | Mortar and Pestle | As specified by factory | 40,000 |
| | Filings | Mortar and Pestle | As specified by factory | 39,920 |
| | Filings | Mortar and Pestle | As specified by factory | 23,000 |
| D | Filings | Mortar and Pestle | As specified by factory | 33,400 |
| | Filings | Mortar and Pestle | As specified by factory | 38,000 |
| | Filings | Mortar and Pestle | As specified by factory | 19,400 |
| E | Filings | Mortar and Pestle | As specified by factory | 20,000 |
| | Filings | Mortar and Pestle | As specified by factory | 34,600 |
| | Filings | Mortar and Pestle | As specified by factory | 48,600 |
| F | Filings | Mortar and Pestle | As specified by factory | 20,600 |
| | Filings | Mortar and Pestle | As specified by factory | 19,000 |
| | Filings | Mortar and Pestle | As specified by factory | 26,000 |

none of the crushing strengths is very high.

### Conclusion

From these experiments we can draw the conclusion that none of the restorations placed in the mouth have a high crushing strength. It seems that the extremely high crushing strengths are obtained through packing. This can be explained by the fact that the packing time in the mouth is limited, whereas it is not on the experimental table. There is some controversy as to whether or not mercury can be added to a stiff mix and be reamalgamated to produce a good amalgam. If it can, the packing time will be unlimited; hence, a denser amalgam having a greater crushing strength.

We find that the average crushing strength in the mouth is from 300 to 400 pounds per square inch and in extreme cases, it may reach 600 pounds per square inch. In that case it does seem foolish to spend all the time, money, and energy experimenting and advertising about alloys having a crushing strength of 50,000 or more pounds per square inch. It would seem that some of this energy would be better directed at expansion, contraction, and tensile strength. It is known that an alloy can have a great crushing strength, but if the expansion and contraction are great and the tensile strength is low the restoration will not be satisfactory.

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# The Editor's Page

WITHIN the last several years dentists have become acutely conscious of the subject of foods and nutrition. A great deal is still conjecture, but that there is some connection between the incidence of dental disease and nutritional states is an accepted fact; that there is likewise a definite relationship between nutrition and the future of man was recently suggested in the presidential address of Doctor James S. McLester[1] when he assumed the office of President of the American Medical Association on June eleventh. As Doctor McLester pointed out in his address, the food habits of people determine in part their cultural level. If, for instance, the food habits of a people are low in nutritive value, because of poor supply or because of religious restriction, there is a likelihood of deterioration of the family or the race; conversely, if the habits provide adequate nourishment, the family or racial group will show an increasing physical vigor and a higher level of cultural advancement.

We are all aware that the fuel, as represented by food, which feeds the human mechanism has not only quantitative but qualitative implications. Mere bulk may supply the demands of hunger, but food must represent more than bulk to meet the requirements of metabolism. Doctor McLester has pointed out that the past one hundred years in the history of medical science and art has conferred upon people who have been conscious of the rôle of bacterial and infectious diseases a better health and a higher cultural life. He predicts for "those races who will take advantage of the newer knowledge of nutrition, a larger stature, greater vigor, increased longevity, and a higher cultural attainment."

Dentists who attempt to control the incidence of dental disease by dietary régimes must be constantly aware of the fact that certain people present idiosyncracies to certain of the common food stuffs. For example, milk is generally accepted to be a highly nutritive food, but there are persons who have a peculiar sensitiveness to this food. In a series of four hundred persons studied by Alvarez and Hinshaw[2], 7 per cent were unable to drink milk because of the marked distress produced. In another study made by Rowe[3] food sensitiveness in some degree was complained of by 37 per cent of the university students examined. Vaughan[3], on the other hand, in a house-to-house canvass among villagers of Virginia, found that 62.6 per cent of persons complained of food sensitiveness.

Alvarez and Hinshaw believe that severe reactions following the ingestion of certain foods are of two general types: (1) allergic, which probably represents the entrance of unchanged protein into the blood stream; (2) local irritation of the intestinal mucous membrane, produced by chemicals or woody cellulose. The reaction from certain foods may vary from a mild distress to severe reaction, such as vomiting, diarrhea, or severe pain. Symptoms outside the gastro-intestinal mechanism, such as urticaria, rashes, and itching, and attacks of migraine, have also been attributed to food reactions. In their order of incidence the following foods gave more or less distress to the persons studied in Alvarez and Hinshaw's series: onions, 27 per cent; milk, cream, ice cream, 26 per cent; raw apples, 26 per cent; cooked cabbage, 25 per cent; chocolate, 18 per cent; radishes, tomatoes, cucumbers, 17, 15, 13 per cent respectively; eggs, 13 per cent; fats, greasy and rich foods, 12 per cent; cantaloupe and meat, 11 per cent; strawberries and coffee, 10 per cent; and certain other foods in lower percentages.

Certain common foods seldom cause untoward symptoms. Alvarez and Hinshaw make use of these foods in attempting to ascertain a nondistressing diet. Such a diet is used as a basis; other foods are tried gradually in order to determine specific food sensitiveness. In this basic diet these investigators suggest that the protein demand be met by the use of lamb and gelatin; fat by the use of butter; carbohydrate by the use of cane, beet or maple sugar, and rice; vegetable requirements by the use of beets, asparagus, peas, potatoes, egg plant, turnips, and parsnips; fruit requirements by the use of cooked pears. Because the régime is usually carried on over a short period there is no appreciable danger of developing avitaminosis or mineral imbalance.

[1]McAlester, J. A.: Nutrition and the Future of Man: Presidential Address, J. A. M. A. 104:2144 (June 15) 1935.

[2]Alvarez, W. C. and Hinshaw, H. C.: Foods That Commonly Disagree with People, J. A. M. A. 104: 2053 (June 8) 1935.

[3]Cited by Alvarez and Hinshaw, footnote 2.

If dentists are to continue to take an interest in nutritional studies, which is highly desirable, it must be repeatedly emphasized that they must understand the chemistry of nutrition and the idiosyncracies of patients, and that they must think in terms of the total organism. To dismiss a dental patient with a stock diet and to ignore the matter of digestibility and individual susceptibilities does not represent rational therapy. As we have pointed out before[4], if dentists are to continue to aid their patients with suggestions for nutritional reinforcement, they should do so preferably in cooperation with the patient's physician.

[4]THE DENTAL DIGEST, Editorial 41:49 (February) 1935.

## ABOUT OUR CONTRIBUTORS

The drawing of the fifth or trigeminal nerve that appears in the series THE EDUCATION OF THE DENTAL PATIENT has been specially prepared for THE DENTAL DIGEST by Mrs. Sarah Cobun Donald. Mrs. Donald received her B. A. degree from the Carnegie Institute of Technology and has spent two years at Johns Hopkins University in the department of Max Brodel, the eminent medical artist. In the preparation of this drawing Mrs. Donald was given the cooperation of the department of anatomy of the University of Pittsburgh School of Dentistry, and Doctor Thurlow W. Brand and his assistant Doctor George M. Stewart were of particular help to Mrs. Donald in this work. Mrs. Donald's address is 1433 Alabama Avenue, Dormont, Pa., South Hills Branch, Pittsburgh.

PAUL HERBERT BELDING (D.D.S., 1919, State University of Iowa) has a general practice, and LELAND JAMES BELDING (M.D., 1927, State University of Iowa) is a Lieutenant in the Medical Corps of the United States Navy. The Doctors Belding have been engaged in private research relative to the spirochetoses for ten years and have made numerous contributions on this subject to the dental literature. The article appearing in this issue was especially prepared for THE DENTAL DIGEST. The senior author is a member of the A. D. A. and affiliated local societies; the junior author is a member of the A. M. A.

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